beside the Willard lens. By this means it is possible to obtain two one-hour exposures each night, together with one two-hour exposure, which will show more of the faint detail. The apparatus was used in this way on the nights of July 19th and 20th. Measures made on the point of forking of the principal tail on the short-exposure plates of July 20th indicate a component of velocity of recession from the head, perpendicular to the line of sight, of about seventy miles per second. This apparent motion of the point of forking may be real, or it may be an illusion due to the closing together of the two branches of the fork, which would cause the point of separation to seem to move outward.

The comet is now of the third magnitude, and is rapidly growing brighter. Since July 17th the tail, as well as the nucleus, has been visible to the eye. An ephemeris computed from CRAWFORD'S elements shows that the comet will reach its maximum theoretical brilliancy about August 20th, when it will be about twenty times as bright as on June 15th and about twice as bright as it is now. This calculation is of course based on the assumption that all of its light is reflected sun-light, and the actual brilliancy may much exceed the theoretical. At the time of perihelion the comet will be about an hour and a half west of the Sun in right ascension, and it is hoped to extend the series of photographs much further.

LICK OBSERVATORY, July 24, 1907. J. C. DUNCAN.

SPECTROGRAPHIC OBSERVATIONS OF VENUS FOR SOLAR PARALLAX.

The determination of the solar parallax by spectrographic methods has long been under consideration among astrophysicists, but until very recently it has been thought to be out of the reach of spectrographs now in use. The work of taking a series of spectrograms of stars having small latitude was begun by Sir DAVID GILL at the Cape Observatory, and is now in progress. The accuracy with which this series will determine the solar parallax has not yet been fully ascertained; at least it has not been published. Professor KÜSTNER, in an article reviewed by Dr. J. H. MOORE in Vol. 17, 197, of these *Publications,* gets a p. e. of $\pm 0.22^{km}$ for a single plate of *Arcturus;* using eighteen plates, he obtained the value $8''.844 \pm 0''.017$ for the parallax.

The measures of check-plates of *Venus,* taken with the remounted Mills spectrograph in 1904 and 1905, agreed well enough to warrant the taking of a few plates at each of two successive elongations of the planet, to see what weight a value of the solar parallax would have if determined spectrographically from *Venus* alone, and to find out what increase of power would be necessary to put this method on a par with the most accurate of those now in use.

The elements of the orbits of the Earth and the other planets are well determined, but the dimensions are relative. If at any time we can determine the absolute distance from the Earth to another planet, or measure the velocity of any planet with respect to the Earth the absolute size of the whole system can be readily found. Knowing the size of the orbit of *Venus* relative to that of the Earth, the velocity of light and a few absolute wave-lengths we can determine the solar parallax by spectrographic observations of the planet.

While the velocity of *Venus* with respect to the Earth is not so great as that of the Earth with reference to a star on the ecliptic, and while the large hour angles necessary in taking spectrograms of *Venus* are inconvenient, if not prejudicial, the brightness of the planet and freedom from unknown changes in velocity due to satellites and from small spectral variations such as may be encountered in stars, will more than counterbalance the disadvantages when we come to use a more powerful apparatus, such as we are about to discuss. The spectrographic method in general is relatively unaffected by the things that are troublesome in other methods, the most important of which is refraction, and perhaps least important, on account of its accurate determination, the size of the Earth. This method must assume DOPPLER's principle.

The measurements of the two series of plates taken at the last two elongations of *Venus* showed greater discrepancies than had been expected, and the mean of the two sets differed by 0.4^{km}, so an investigation of the cause for the difference was undertaken. It came out that sky-plates taken with the instrument in the same adjustment as was used for the later series differed from the computed values by the same amount as did the Venus-plates, leading to the conclusion that slight differences in the closure of the slit, or a dust grain, may affect the velocity of a plate by interfering with the symmetry of the

comparison-lines. The value obtained for the probable error of a single Venus-plate was $\pm 0.23^{km}$, of a single sky-plate $\pm 0.18^{km}$. From this we may infer that an instrument five times as powerful would give a result five times as accurate, or a p. e. of $\pm 0.04^{km}$ for a single plate, that is $\pm 0.006^{km}$ for the mean of fifty plates. This would be about the accuracy of an *Eros* determination of the parallax $\pm 0''.004$. A grating ruled 15,000 lines to the inch would give, in the third order, the same angular dispersion as the Mills at λ 4500; 20,000 lines to the inch, third order, or 15,000 lines, fourth order, would give a third more angular dispersion than the Mills, and the resolving power in either case would be over five times that of the Mills if it were a 6-inch grating. The focal length of the Mills camera would have to be multiplied by 3.5 to give sufficient linear dispersion, but it might not pay to increase the collimator focal length in the same ratio, owing to the limited size of gratings that can be ruled. Supposing that this spectrograph and the horizontal telescope necessary to concentrate the light on the slit effectively utilized twenty per cent as much light as the Mills attached to the Lick 36-inch telescope. Throughout the rest of the optical train, the grating would have to throw eight per cent of the incident light into one of the higher orders on one side—not an entirely unknown occurrence—in order to photograph the spectrum of *Venus* in thirty minutes. The Mills gives a dense negative in two minutes. If at one of the next two elongations of *Venus* which are favorable for northern observations a series of plates of the planet and the sky were taken with such a spectrograph as we have considered, and each Venus-plate measured with reference to a separate sky-plate taken the same day, the accuracy of measurement ought to be five times as great as we get with the Mills, and the probable error of a single plate should be as low as $\pm 0.04^{km}$ or $\pm 0.05^{km}$. While we may never get so accurate a value of the parallax by spectrographic methods as by the direct and indirect methods now in use, there is little doubt that a value could be obtained such that its probable error would be much less than the amount by which the values determined directly and indirectly differ, and the result might help to throw light on the cause of the present difference.

LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA. K. BURNS.